

194720: rapakivi metadiorite, Harris Lake

(Biranup Zone, Kepa Kurl Booya Province, Albany–Fraser Orogen)

Location and sampling

ZANTHUS (SH 51-15), COONANA (3535)
MGA Zone 51, 546153E 6534950N

Sampled on 3 July 2008

This sample was collected from a prominent outcrop on the western edge of a small salt lake, about 87 m due west of a north-northwesterly trending track. The sample site is located approximately 7.6 km southwest of Harris Lake, 15.6 km south-southeast of Udarra Soak, and 21.8 km west of Spy Hill.

Tectonic unit/relations

This rapakivi metadiorite, from the central-east of the COONANA 1:100 000 map sheet, has been attributed to the Biranup Zone. The Biranup Zone is part of the Kepa Kurl Booya Province, which represents the pre-amalgamation crystalline basement components of the Albany–Fraser Orogen. The Biranup Zone is dominated by 1690–1660 Ma protoliths, their reworked counterparts, and Mesoproterozoic intrusions (Spaggiari et al., 2009; Kirkland et al., 2010a).

The sample displays distinct mingling textures (Fig. 1) with a metagabbro dated at 1664 ± 7 Ma (GSWA 194721; Kirkland et al., 2010b). Other samples collected for geochronology in the immediate area include: siliciclastic schist with a significant zircon age component at c. 1650 Ma, and 1300–1200 Ma metamorphic zircon rims (GSWA 194722; Kirkland et al., 2010c); a 1659 ± 6 Ma metamonzogranite (GSWA 194723; Kirkland et al., 2010d); and a 1668 ± 11 Ma metasyenogranite (GSWA 194724; Kirkland et al., 2010e).

Petrographic description

The sample contains ovoid rapakivi feldspars, tabular euhedral feldspars, and rounded quartz phenocrysts, within a fine- to medium-grained groundmass. The sample's visually estimated mineralogy includes about 35% plagioclase, 30% quartz, 25% microcline, 6–8% biotite, 1–2% garnet, and 1–2% hornblende–epidote. Accessory minerals include apatite and zircon. The rapakivi texture is defined by grains up to 15 mm long and 10 mm wide, with cores of microcline (up to 10×6 mm) rimmed by aggregates of inequigranular, coarse-grained plagioclase, and quartz. Discrete euhedral

plagioclase grains are also present and contain small inclusions and interstitial patches of microcline and quartz. Some plagioclase grains contain needles of epidote and minor sericitized cores. Aggregates of biotite(–hornblende) are developed within some plagioclase-rich rims on K-feldspar grains, but can also form discrete clots. Garnet, epidote, and hornblende are associated with the biotite aggregates. Large biotite grains, up to 2 mm long, occur outside the polycrystalline clots, and possess fringes of fine-grained biotite at each end of the crystal. Parts of the groundmass are rich in microcline with less abundant quartz, plagioclase, and biotite, whereas other areas are largely composed of quartz and biotite aggregates. In some areas, there is evidence for garnet formation by the replacement of biotite aggregates.

Zircon morphology

Zircons isolated from this sample are subhedral to euhedral, colourless to brown, up to 300 μm long, and have aspect ratios up to 5:1. Cathodoluminescence (CL) images reveal oscillatory zoning. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 9–10 March 2009, using SHRIMP-B. Thirteen analyses of the Temora standard were obtained during the session and indicated an external spot-to-spot (reproducibility) uncertainty of 2.15% (1σ) and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.62% (1σ). Calibration uncertainties are included in the errors of $^{238}\text{U}/^{206}\text{Pb}^*$ ratios and dates listed in Table 1. Common-Pb corrections were applied to all analyses using contemporaneous common-Pb isotopic compositions determined according to the model of Stacey and Kramers (1975).

Results

Twenty-three analyses were obtained from 23 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3).

Interpretation

The analyses are essentially concordant (Fig. 3), and define a single coherent group based on $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.



Figure 1. Field photograph of sample 194720: rapakivi metadiorite, Harris Lake, showing magmatic mingling textures with a coeval metagabbro (GSWA 194721). Pen is 135 mm long.

Group I comprises 23 analyses (Table 1), which yield a concordia age of 1665 ± 6 Ma (MSWD = 1.7). The analyses have highly variable U contents (67–500 ppm) and Th/U ratios (0.33–2.23).

The date of 1665 ± 6 Ma for the 23 analyses in Group I is interpreted as the age of magmatic crystallization for the quartz diorite protolith. This is consistent with the crystallization age of 1664 ± 7 Ma obtained for the metagabbro mingled with this sample (GSWA 194721; Kirkland et al., 2010b)

References

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- Spaggiari, CV, Bodorkos, S, Barquero-Molina, M, Tyler, IM and Wingate, MTD 2009, Interpreted bedrock geology of the South Yilgarn and central Albany–Fraser Orogen: Geological Survey of Western Australia, Record 2009/10, 84p.
- Stacey, JS and Kramers, JD 1975, Approximation of terrestrial lead isotope evolution by a two-stage model: *Earth and Planetary Science Letters*, v. 26, p. 207–221.

Recommended reference for this publication

Kirkland, CL, Wingate, MTD, Spaggiari, CV and Pawley, M 2010, 194720: rapakivi metadiorite, Harris Lake; Geochronology Record 852: Geological Survey of Western Australia, 4p.

Data obtained: 10 March 2009

Data released: 31 May 2010

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	^{232}Th ^{238}U	f_{204} (%)	$^{238}\text{U}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{238}\text{U}/^{206}\text{Pb}^*$		$^{207}\text{Pb}/^{206}\text{Pb}^*$		$^{238}\text{U}/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}^*$ $\pm 1\sigma$	date (Ma)	$^{207}\text{Pb}/^{206}\text{Pb}^*$ $\pm 1\sigma$	date (Ma)	$^{207}\text{Pb}/^{206}\text{Pb}^*$ $\pm 1\sigma$	Disc. (%)
							$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$	$\pm 1\sigma$									
I	14	14.1	156	60	0.40	0.350	3.328	0.077	0.10296	0.00088	3.339	0.077	0.09993	0.00119	1689	35	1623	22	-4.1		
I	16	16.1	67	39	0.60	0.122	3.382	0.082	0.10102	0.00105	3.386	0.082	0.09996	0.00108	1668	36	1623	20	-2.7		
I	5	5.1	156	89	0.59	0.103	3.418	0.079	0.10135	0.00068	3.421	0.079	0.10046	0.00071	1653	34	1633	13	-1.3		
I	11	11.1	242	111	0.47	0.044	3.288	0.079	0.10122	0.00056	3.289	0.079	0.10084	0.00066	1711	37	1640	12	-4.4		
I	19	19.1	260	83	0.33	0.041	3.450	0.079	0.10123	0.00054	3.451	0.079	0.10087	0.00056	1640	34	1640	10	0.0		
I	20	20.1	394	195	0.51	0.081	3.396	0.077	0.10175	0.00065	3.399	0.077	0.10104	0.00067	1662	34	1643	12	-1.2		
I	4	4.1	211	111	0.54	0.336	3.465	0.083	0.10409	0.00062	3.477	0.083	0.10118	0.00087	1630	35	1646	16	1.0		
I	10	10.1	198	91	0.47	0.120	3.418	0.079	0.10223	0.00062	3.422	0.079	0.10119	0.00072	1653	34	1646	13	-0.4		
I	9	9.1	357	161	0.47	0.060	3.363	0.076	0.10177	0.00046	3.365	0.076	0.10125	0.00047	1677	34	1647	9	-1.8		
I	15	15.1	282	218	0.80	-0.014	3.294	0.075	0.10148	0.00050	3.293	0.075	0.10160	0.00056	1709	35	1654	10	-3.4		
I	2	2.1	169	59	0.36	-0.026	3.396	0.088	0.10161	0.00066	3.395	0.088	0.10183	0.00067	1664	39	1658	12	-0.4		
I	7	7.1	155	64	0.43	-0.009	3.356	0.078	0.10204	0.00068	3.355	0.078	0.10212	0.00114	1681	35	1663	21	-1.1		
I	18	18.1	241	87	0.37	-0.062	3.367	0.077	0.10184	0.00056	3.364	0.077	0.10237	0.00056	1678	35	1668	10	-0.6		
I	13	13.1	78	39	0.52	0.052	3.325	0.079	0.10285	0.00095	3.327	0.079	0.10240	0.00097	1694	36	1668	18	-1.6		
I	17	17.1	298	141	0.49	-0.041	3.388	0.078	0.10215	0.00051	3.386	0.078	0.10251	0.00051	1668	35	1670	9	0.1		
I	3	3.1	275	165	0.62	0.065	3.378	0.077	0.10315	0.00052	3.381	0.077	0.10259	0.00100	1670	34	1672	18	0.1		
I	8	8.1	244	113	0.48	0.007	3.401	0.079	0.10268	0.00057	3.402	0.079	0.10262	0.00076	1661	35	1672	14	0.6		
I	22	22.1	204	93	0.47	0.003	3.339	0.077	0.10281	0.00060	3.339	0.077	0.10279	0.00065	1689	35	1675	12	-0.8		
I	12	12.1	500	208	0.43	-0.006	3.377	0.085	0.10308	0.00039	3.377	0.085	0.10314	0.00039	1672	38	1681	7	0		

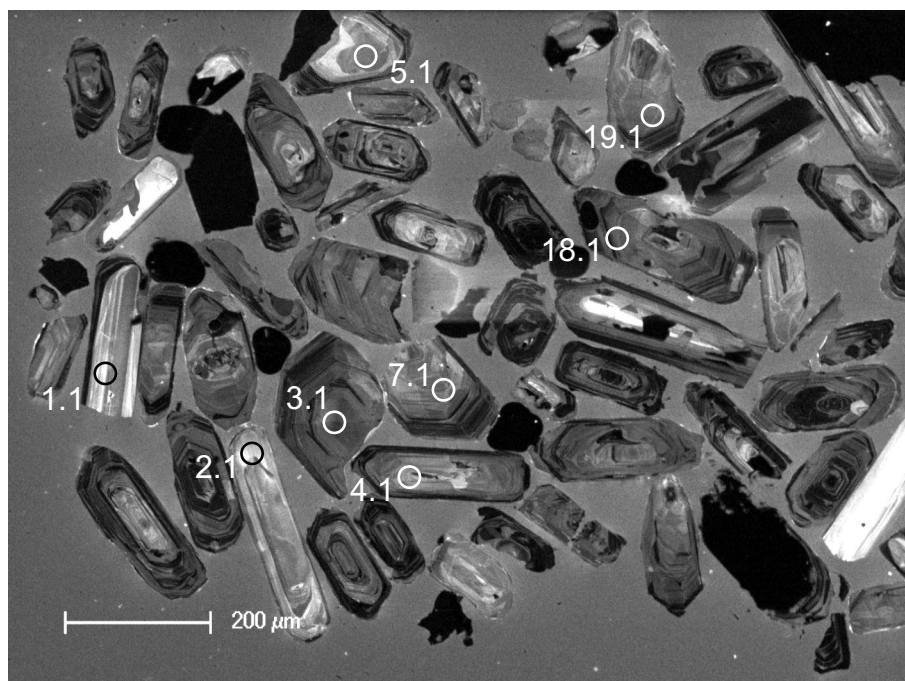


Figure 2. Cathodoluminescence image of representative zircons from sample 194720: rapakivi metadiorite, Harris Lake. Numbered circles indicate the approximate positions of analysis sites.

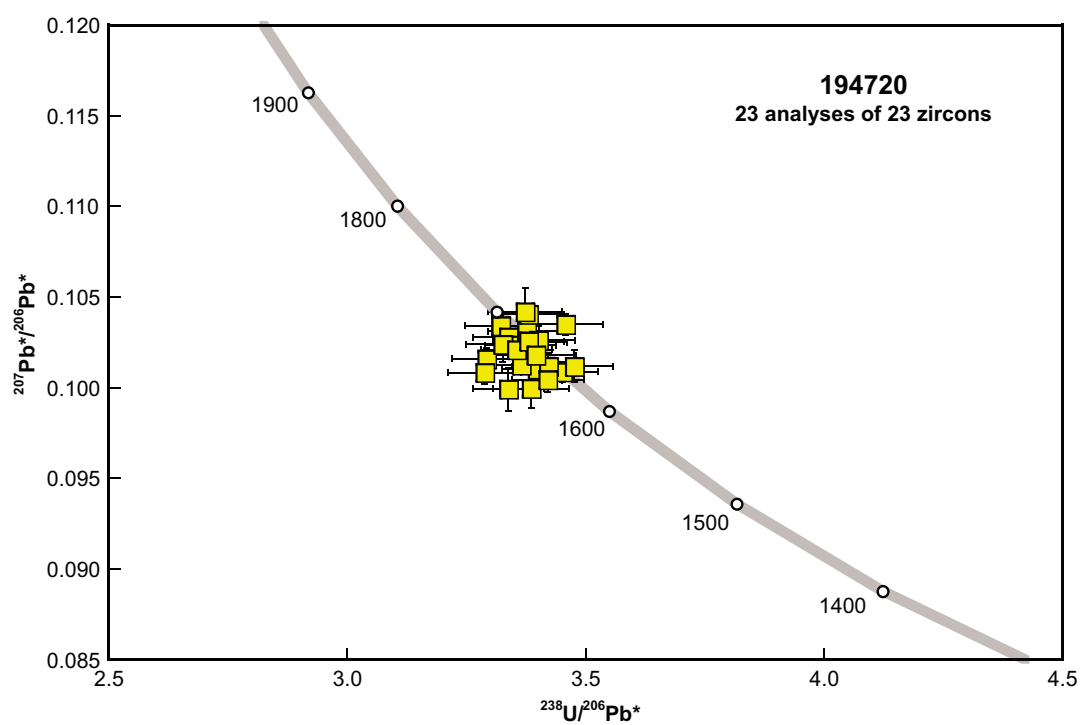


Figure 3. U-Pb analytical data for sample 194720: rapakivi metadiorite, Harris Lake. Yellow squares indicate Group I (magmatic zircons).